DOCUMENT RESUME

ED 441 033 TM 030 832

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TITLE The Role of Feedback on Studying, Achievement and Calibration.

PUB DATE 2000-04-00

NOTE 8p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 24-28, 2000).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Academic Achievement; Computer Assisted Instruction; *Feedback; *High School Students; High Schools; *Study

IDENTIFIERS *Calibration; Self Regulation

ABSTRACT

One set of hypotheses examined in this study was that various types of feedback (outcome, process, and corrective) supply different information about performance and have different effects on studying processes and on achievement. Another set of hypotheses concerned students' calibration, their accuracy in predicting and postdicting achievement compared to actual achievement and their perceptions of studying compared to actual studying. In the first experimental sessions, students were assigned to corrective feedback (n=22), process feedback (n=21), corrective plus process feedback (n=21), and no feedback (n=19) conditions. Students used a computerized studying tool, PrepMate, and studied a chapter on lightning and storms. In the second session, students used PrepMate to study pumps and then commented on their own studying and achievement. Regardless of the type of feedback students received, findings indicate that students were moderately calibrated between their recalled and actual study tactic, slightly overestimated their use of tactics, and had a small magnitude of judgment error. Results support previous research which indicates that confidence, bias, and discrimination do not change across testing conditions and which implies that students have a general monitoring skill. Results support the notion that self-regulation is an important part of the studying and achievement cycle. Process feedback had no effect on calibration. Possible explanations for this lack of effect are discussed. (Contains 20 references.) (SLD)

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The Role of Feedback on Studying, Achievement and Calibration

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Objectives, Purposes, and Theoretical Framework

One set of hypotheses examined in this study was that various types of feedback—outcome, process, and corrective feedback—supply different information about performance and have different effects on studying processes and on achievement. *Outcome feedback*, often called *knowledge of results*, is information provided after task engagement is over about qualities of products created, e.g., a grade (Butler & Winne, 1995; Early, Northcraft, Lee & Lituchy, 1990). It may not be effective if it is the only feedback (Korsgaard & Diddams, 1996), and it may hinder learning in complex tasks (Kluger & DeNisi, 1996) because it provides little information to students about how to adapt studying. *Corrective feedback* supplements knowledge of results by adding the correct response to outcome feedback (Merrill, 1987). Presumably, corrective feedback provides students with a second chance to learn and is an implicit clue about how to adapt studying tactics. *Process feedback* is information about how students engaged in the task (Early, et al., 1990). It provides an explicit basis for adapting studying tactics and implicitly addresses the accuracy of content. The literature suggests that students receive little if any *process feedback* informing them of the manner in which they study (Early, et al., 1990). This is surprising since studying is an important activity in learning.

The second set of hypotheses concerned students' calibration—their accuracy in (a) predicting and postdicting achievement compared to actual achievement, and (b) perceptions of studying compared to actual studying. Research is relatively consistent that students are moderately calibrated about achievement (Glenberg, Sanoki, Epstein & Morris, 1987, Pressley & Ghatala, 1990). However, there is little evidence on students' calibration about studying possibly due to limitations in collecting traces of studying behaviour. If students are poorly calibrated about knowledge and/or their studying, they are in a weak position to self-regulate learning. One study found that calibration was poor, at best (Winne, Hadwin, Stockley, & Nesbit, 1999). To further address the limitation in examining students' reported use and their actual use of study tactics, students in this study studied a chapter embedded in a computer-based studying environment. Feedback about the chapter was predicted to increase calibration, enhance self-regulation and improve achievement. The types of feedback noted above were examined for differential effects on students' calibration of knowledge, studying tactics and effort.

Methods and Data Sources

The experiment spanned two sessions. In the first session, students were randomly assigned to one of four feedback conditions: corrective (ideal response) feedback (n=22), process (study tactics) feedback (n=21), corrective plus process (combined) feedback (n=26), and no feedback (n=19). Students completed a questionnaire requesting demographics and prior knowledge. Next, they completed a practice module instructing them to use *PrepMate* (Chu, Jamieson, Winne & Field, 1998), a Macintosh software studying tool programmed using Winne and Field's (1998) general instructional programming system, STUDY. *PrepMate* is a study environment that presents chapter text and affords several study tactics such as highlighting text, copying and pasting information, viewing figures and accompanying elaborations about figures, and making

notes. *PrepMate* recorded extensive data tracing how students actually studied such as highlights students make, notes they create, whether and when they viewed objectives intended to guide studying, and whether and when they viewed figures and accompanying explanatory elaborations about cause-and-effect systems described in materials they studied.

After the practice module, students used *PrepMate* to study a 916-word chapter on lighting and lightning storms (adapted from Mayer, Bove, Bryman, Mars, & Topangco, 1996). After studying, they completed a 6-item short-answer test. After answering each item, students' postdicted their score relative to the maximum score indicated. Students in the no feedback group were dismissed. Students in the three feedback groups completed a questionnaire where they postdicted the frequency with which they had used various study tactics. Then students in the corrective feedback group and combined feedback group were provided corrective feedback that listed key components for each item's ideal answer. They postdicted whether answers they had written on the test contained each key component listed for each item.

Session 2 took place 1 to 3 days after session 1. Its format depended on experimental condition. The no feedback group immediately studied a 1019-word chapter on pumps (adapted from Mayer & Gallini, 1990) using *PrepMate*. The process feedback group received a handout defining various individual study tactics and explaining how using each tactic could improve studying. They postdicted how frequently they would use each tactic in the first studying session and predicted frequency of using each tactic in the upcoming studying session. Meanwhile, students in the corrective feedback group received the list from session 1 where they had postdicted key components of ideal answers included in their test responses. The list was updated with feedback identifying which components students actually had included in their responses and outcome feedback—the student's grade. The handout also contained students' postdicted item scores from session 1 and the scores on those items assigned by the researcher. The combined feedback group received both handouts. After examining their handout(s), students in the feedback groups studied the chapter on pumps using *PrepMate*.

Results

Feedback and Study Tactic Use: No difference was found between treatment groups when observing the use of low-order study tactics. Prior low-order study tactic use in session 1 was the only unique contributor to the regression model. Furthermore, the model only accounted for 8% of the variance in low-order tactic use in session 2. Similarly, prior high-order study tactic use in session 1 was a statistically significant contributor to the model predicting high-order tactic use in session 2. A statistically significant difference was found between treatment groups when the process-plus-feedback was compared to the control group. The model accounted for 23% of the variance in high-order study tactic use in session 2, $p<.001$. Analyses examining the effects of feedback within condition groups suggested that there were no statistically significant changes in low- and high-order study tactic use due to feedback. Therefore, further investigation of change from session 1 to session 2 within each condition group was not warranted.

Although feedback effects between groups were not observed based on the statistical analyses, many participants none-the-less reported that feedback did affect their studying. The 48 *corrective feedback* recipients reported that the feedback had a moderate influence on their studying and they cited several reasons. Fifty-three percent of respondents stated that they changed their approach to studying in the second session by using study strategies and tactics

learned about or not previously considered in the first session. The two foremost reasons why corrective feedback affected studying were that it provided information applicable to the next test (30%) or prompted a desire to improve their performance in the second session (28%). Forty-seven *process feedback* recipients reported that the feedback moderately influenced their approach to studying. Ninety-two percent reported using study strategies and tactics learned about or not previously considered in the first session. Reasons for using the feedback included the belief that paying attention to the feedback may improve studying, or may make studying easier or more efficient (33%), or the feedback informed them of study strategies and tactics not known or not used before (23%).

Feedback and Achievement: Previous achievement score in session 1 was found to be a statistically significant predictor in the model and was entered in the first step. Reported effort in session 2 was included in the second step. A difference among feedback groups was found when the process-plus-corrective feedback treatment group was compared to the control group. The model accounted for 39% of the total variance in achievement for session 2, $p<.001$. An analysis investigating change in achievement within feedback groups from session 1 to session 2 yielded no statistically significant results.

Although findings on the effect of feedback on achievement were not observed, 48 *corrective feedback* recipients reported that the feedback moderately affected their approach to test-taking. Seventy-three percent reported that they used the suggestions on how to answer the test questions while several students used study strategies and tactics they learned about or did not previously consider in the first session. To explain why the feedback influenced their test-taking, 32% participants considered their test scores while many others felt that the feedback provided suggestions applicable to the next test. *Process feedback* was perceived by 47 recipients to have a small effect on their approach to test-taking. Forty-nine percent indicated that they used study strategies and tactics learned about or not previously used in the first session. These strategies and tactics helped participants to prepare and to think about the test (19%). Many students believed that paying attention to the feedback could help them to improve their understanding, learning, recall, performance, studying and focus (27%).

Calibration: Study tactics were categorized as high- or low-level based on types of cognitive processing they traced. After module 1, all students were moderately calibrated at both levels of tactics, $r=.65$ and $r=.61$, respectively ($ps<.01$), and there was no difference in calibration as a function of cognitive level of study tactic. Compared to students' use of high-order study tactics, they made greater overestimations and had higher magnitudes of judgement error for their use of low-order study tactics. Calibration for achievement for the participants as a whole, was also moderate, $r=.63$. $p<.01$. Overestimation of achievement occurred, but was rather small. Magnitude of judgement error was low as well.

Feedback was expected to influence *calibration for studying*. Moderate calibration occurred for all groups and all groups overestimated their use of study tactics, but no significant change in calibration appeared to have occurred between session 1 and session 2 for any of the three feedback groups. However, when calibration between the three groups was examined, statistically significant differences emerged. Corrective feedback recipients were better calibrated in their use of high-order study tactics than either the process feedback group (Fisher's $z=3.15$, $p<.01$) or the process-plus-corrective feedback group (Fisher's $z=3.02$, $p<.01$). Furthermore,

when bias within each group was examined, process-plus-corrective feedback recipients decreased their overestimations of low-order study tactic use.

Feedback had no effect on *calibration for achievement* when the three feedback groups were investigated. There did not appear to be any changes in calibration for any of the three feedback groups and differences in calibration between the groups were not observed. No changes occurred for bias or magnitude of judgement error for any of the groups.

Feedback and Reported Effort: Feedback did not affect overall reported effort between groups. The model accounted for 35% of the variance in reported effort in session 2, however only reported effort for session 1 was entered into the model. A test of change in reported effort from session 1 to session 2 with condition groups did not yield any statistically significant results. Again, results do not coincide with students' reports. Specifically, a majority of students (65%) reported an increase in their effort in the second study session. The most common reason for how change occurred was an attempt to change their studying (25%). Several other students reported differences in concentration or focus between the two study sessions (14%). Sixty-one percent of participants also reported an increase in their effort in the second test session, commonly declaring that a change in their effort in studying lead them to change their effort in test-taking (24%).

Conclusions and Implications

Regardless of the type of feedback students received, findings indicated that students were moderately calibrated between their recalled and actual study tactic use, slightly overestimated their use of tactics and had a small magnitude of judgement error. Furthermore, students were moderately calibrated between their postdicted and actual performance, slightly overestimated achievement and had a modest magnitude of judgement error. Therefore, results supports Schraw, Dunkle, Bendixen, and Roedel's (1995) finding that confidence, bias, and discrimination do not change across testing conditions and implies that students have a general monitoring skill. In general, these results suggest that students are relatively accurate when considering their behaviour and seem to be aware of the tactics they use in studying. Furthermore, previous research suggests overconfidence is common (Cervone & Wood, 1995; Glenberg & Epstein, 1987; Schraw et al., 1993) and may have been a result of students' epistemological beliefs such as that learning is simple or a result of inadequate internal feedback leading to deficiencies in monitoring (Butler & Winne, 1995).

Results support that self-regulation is an important part of the studying and achievement cycle and implies how motivation, effort and self-efficacy are related to study tactic use and performance. In self-regulation, internal or external standards are used to evaluate one's behaviour (Schraw et al., 1993) and feedback provides information upon which to judge one's behaviour against the standards (Winne, 1995). Statistical results do not strongly support the effects of feedback, however, open-ended responses suggest that students were more self-regulating in the second session due to the feedback and as a result, effort increased. Since the use of studying strategies did not change across the two sessions, this suggests that corrective feedback or process feedback by itself does not enhance self-efficacy, whereas providing both types of feedback may. This implies that a one-time offering of process feedback is not enough to promote the development of tactics and strategies and their application to studying and achievement tasks. Instead, cognitive strategy instruction should be made a routine part of

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content-based instruction as suggested by Kardash and Amlund (1991) beedback that enables students to gauge their progress toward a goal has been linked to improved self-efficacy judgement and performance (Cervone & Wood, 1995).

Process-plus-corrective feedback had a statistically significant effect on achievement, whereas the other treatment groups did not. This is not consistent with previous general findings that feedback groups outperform control groups (e.g., Lhyle & Kulhavy, 1987) and may have been a result of the previously discussed issues related to the lack of sufficient information provided by corrective feedback and process feedback, separately.

In terms of feedback effects on calibration, some results were unexpected. For example, the finding that process feedback had no affect on calibration. One explanation is that process feedback may not have been presented at the appropriate time. Providing students with process feedback after studying has occurred may not have been conducive to its application in the next studying session. Alternatively, since some students were given outcome, corrective and process feedback all at the same time they may have been cognitively overwhelmed. The issue of cognitive overload has several implications. First, if participants allotted more effort and cognitive resources to monitoring, then focus on the actual content may have suffered and learning may have been compromised. Therefore, statistically significant changes in achievement were not detected. Second, if students' cognitive focus was already taxed, then giving students feedback may have further complicated their juggling of cognitive resources. Even students who acknowledged the benefits of various study tactics, may have reverted to strategies they relied on in the past due to cognitive overload. Thus, appropriate and increased use of study tactics and the potential effects of the different feedback may have been overridden.

A second explanation for why process feedback did not have an effect on studying or achievement was a lack of personally meaningful contextual information upon which students could base judgements about appropriate study tactic use. In order for strategy instruction to be successfully embedded within academic tasks, students need to acquire the metacognitive skills of when and how to use the new strategies (Mayer, 1998). Furthermore, Mayer adds that, "for more complex problems, students may lack the ability to organize and control the basic skills within the context of solving the higher-level task" (p. 52). Therefore, calibration in this study may not have changed across sessions due to students' inability to organize these skills or to change their approach for the second session to the extent where differences in achievement would be fostered.

The results also suggest that students did not discern the connection between studying and test-taking and how changes in studying can also be applied to test-taking. Although feedback about the use of study tactics and strategies was provided to some students and they reported applying the suggestions, the effects did not carry over to the achievement test. In fact, a few students noted that process feedback did not have any relationship to test-taking.

In summary, this study provided an introductory and exploratory examination of calibration and the effects of instructional feedback and has only touched upon some of the important issues and considerations. Thus, further research is needed to understand why and how feedback may help students to better monitor their studying and test-taking activities and thereby, make better predictions of their performance. In addition, further research may determine the types of feedback, appropriate timing and methods necessary to improve studying and achievement.

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